DOCUMENT RESUME

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ABSTRACT

This module on planning skills contains the product development unit in a manufacturing course for grades 10, 11, and 12. The module helps students develop thinking, communication, and problem-solving skills and acquire knowledge relating to creation, retrieval, and use of information found on common project plans. The content outline includes the following sections: communication skills; problem-solving skills; thinking skills; retrieving and processing information skills; project plan creation; and bill of materials. Methodology, activities, and evaluation procedures for this module are outlined. The following materials are provided: a planning module; pretest; an information sheet; a print reading work sheet; a bill of materials information and an instruction sheet; a board measure table; a material price list; and a posttest planning module. (NLA)

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ED347336

High-Technology Training Module

Module Title: PLANNING SKILLS

Unit: PRODUCT DEVELOPMENT

Course: MANUFACTURING

Grade Level (s): 10, 11, 12

Developed by: ALLEN VOBEJDA

Date: APRIL 20, 1990

School: BALDWIN-WOODVILLE HIGH SCHOOL

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Developed as a part of the High-Technology Training Model for Rural Based Business and Industry, Technical Colleges and Local and State Educational Agencies under Grant No. V199A90151.

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Objectives:

Module objective:

To help students develop thinking and communicating skills and acquire knowledge that relates to: the creation of, retrieval from, and use of information found on common project plans.

Specific Objectives:

The student will be able to:

- explore and practice thinking and communication skills
- work with simple problem solving skills
- understand and practice the How, What, Where, and Why of gathering information
- understand the necessary components needed to communicate ideas through drawn plans
- understand the concept of scale drawing
- communicate ideas through the creation of multi view project sketches
- retrieve and process information found on project plans
- select and calculate the cost of materials
- understand the purpose and components of a bill of materials

CONTENT OUTLINE:

I. Communications Skills

1. Purpose of communications
   A. Share ideas
   B. Learn information

2. Communication Methods
   A. Speaking
   B. Gestures
   C. Writing
      1. Content
      2. Understanding
   D. Graphic
      1. Sketching
      2. Drawing
   E. Electronic
      1. Radio
      2. Television
      3. Video

3. Skills
   A. Listening
   B. Following instructions
   C. Giving instructions
      1. Verbal
      2. Written

II. Problem Solving Skills

1. Purpose and use of problem solving

2. Components
   A. What is to be accomplished?
   B. What is known?

C. What needs to be found?
D. How could it be done?
E. How do you know it will work?

III. Thinking Skills

1. Limiting factors

2. Expanding ideas

3. Logical thinking

IV. Retrieving and Processing Information Skills

1. Purpose
   A. Information
   B. Knowledge

2. Methods
   A. Ask questions
   B. Do research

3. Sources
   A. People
   B. Data base
   C. Periodicals

V. Project Plan Creation

1. Purpose of plans

2. Components
   A. Kinds of Views
      1. Multi-view
      2. Isometric

B. Dimensions
   1. Overall
   2. Location
   3. Detail
C. Shop notes
D. Scale drawings
   1. Purpose
   2. Kinds
E. Construction
   1. Joints
   2. Fastening methods

VI. Bill of Materials
   1. Purpose
   2. Components
      A. Item description
      B Number of pieces
      C. Dimensions
         1. Squaring
         2. Roughing
      D. Quantity
      E Unit cost
      F. Total cost

Methodology:

- lead class discussions
- prepare instruction, information, data, evaluation and assignment sheets
- gather necessary instructional materials
- help students with problems
- evaluate student progress and understanding

Activities:

- create and share written instructions
- participate in class discussions
- take pre and post tests
- read information sheets and retrieve information from drawer plans
- fill out work sheet and bill of materials form for drawer
- do problem solving and gather pertinent information for a project
- create and sketch plans for a project
- fill out bill of materials form for a project

Resources:

- pre and post tests
- information sheet and bill of materials form
- multi-view plans of drawer
- work sheet
- 1/4" graph paper, pencil, ruler or straight edge
- Bill of Materials form
- evaluation checklist
- area chart and materials price list

Evaluation:

1. Participation in class discussions and activities

Actively participates	15 points
Usually participates	12 points
Sometimes	9 points
Seldom	6 points
Rarely	3 points

2. Work sheet on print reading

	Yes	No
Turned in on time	____	____
Completed	____	____
Correct information	0 - 26 points	

(1 point for each correct answer)

3. Checklist on bill of materials for drawer, plans for project, and bill of materials for project

4. Written test on content covered by the module
   - each question worth 2 points
   - this test will be used as both a pre and post test for the module

Name _____

Pre-Test
Planning Module

1. Why are notes often added to drawings?

2. What is the primary purpose of arrows on a drawing?

3. Why are three view drawings commonly used for project plans?

4. What are squaring dimensions?

5. Why are dimensions put on blue prints? What are the two common types?

6. Why is lumber listed as 1" in thickness when it is usually thinner?

7. Why are drawings usually drawn to scale?

8. What does 1/2" scale mean?

9. What are three things a good set of project plans would show?

10. In what order are the dimensions for a piece of lumber given?

11. What do hidden lines on a drawing show?

12. What are three types of information that would be found on a bill of materials?

13. What are rails and styles?

14. How are size and location dimensions different from each other?

15. Why is a complete set of project plans necessary before starting a project?

16. Why is it necessary to have a Bill of Materials before starting a project?

17. Why is the front view on a drawing usually made first?

Information Sheet

Before a product can be produced, a variety of planning activities need to be completed. Some of these include design, drawing plans and filling out a bill of materials. The purpose of the following activities are to help you understand: what goes into a complete set of project plans, how to retrieve information from them, and how to fill out a bill of materials.

Drawings, whether they are simple sketches or detailed blue prints, are created for the same purpose. They take an idea and put it on paper to make it easier to understand. Complete blue prints show construction details, sizes, shapes, and materials necessary to build something. Understanding the terminology and components found on common prints and plans are necessary for you to read and retrieve information from them.

Most project plans have **three views** drawn on them. They are front, top and right side views. Normally, the front view shows the details of the product best and is drawn first. Then the information used to create that view is projected out to draw the top and side views. In addition, an isometric drawing is often included to make the plans easier to understand. An isometric drawing is like a photograph of the object being described.

A complete set of plans contains all the dimensions necessary to build the product. **Dimensions** are put on drawings to give the sizes and location of all the parts. Each individual part needs dimensions that show the thickness, width and length of that part. There are special types of dimensions used to do special tasks. **Size** dimensions, for example, are used to describe the size of individual parts or details. **Location** dimensions show where some part or detail is located in relation to some other position on the drawing. **Arrows** are used on a drawing to help explain the size of parts. They show precisely where a dimension begins and ends. **Hidden lines** are dashed lines used to show surfaces that are not visible in the particular view you are looking at. They are necessary to help understand the drawing. The hidden surfaces they represent are usually shown clearly in some other view of the drawing.

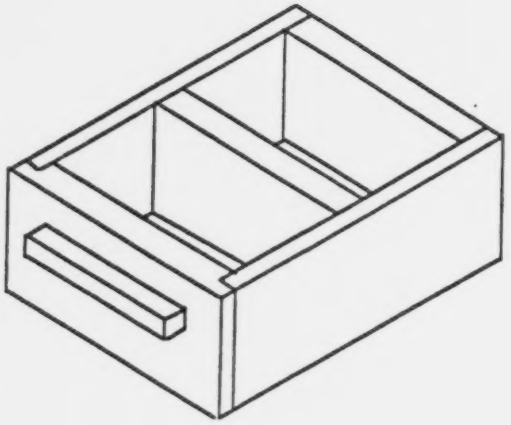
Whenever possible, drawings are made full size - 1" = 1". Many times because of an object's size, and to make it easier to understand, they will be drawn smaller or larger than actual size. This is called drawing to **scale**. When a drawing is larger than actual size, for example 2" = 1", it means the drawing is twice the actual size of the object. A drawing using a smaller
scale might read 1/8" = 1", meaning the drawing is only 1/8 of the actual size of the object.

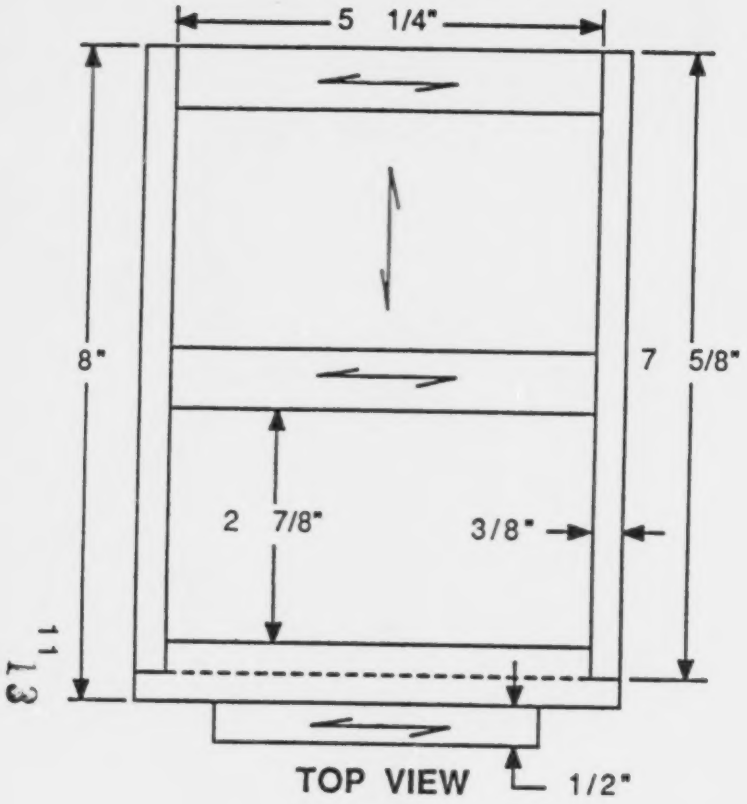
Shop notes are also commonly added to drawings to give information that is needed but cannot be shown some other way. An example might be: (all material 1" oak lumber.)

On the following page, you will find a set of project plans for a small drawer. Study them carefully and answer the questions on the work sheet found on the page following the plans. Upon completion, hand in to the instructor for evaluation.

DRAWER

1/2" SCALE



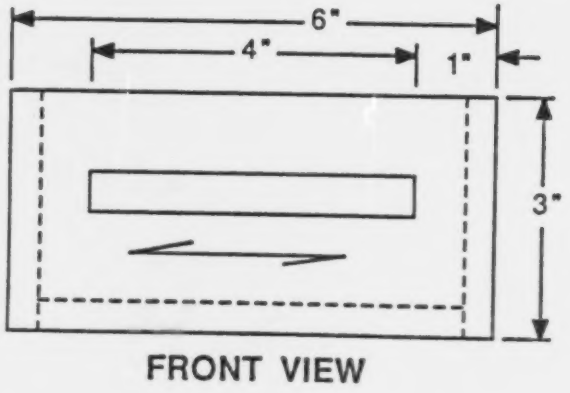


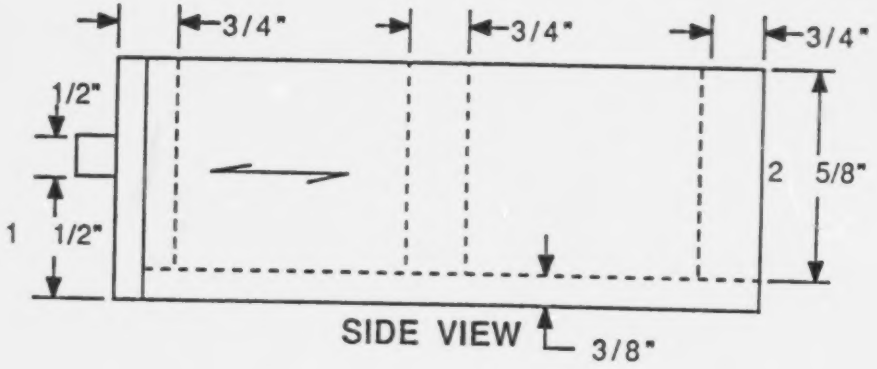
indicates grain direction

Notes: Front, back, divider, and handle are made from pine lumber.

Sides and bottom are made from plywood.

All parts are glued and nailed together.





Name _____

WORK SHEET

PRINT READING

1. What is the thickness of the drawer bottom?

2. What is the the thickness, width, and length of the drawer handle?

3. What is the length of the sides?

4. How many different kinds of materials are used in the drawer? What are they?

5. What is the thickness, width, and length of the front?

6. What are the three location dimensions shown on the drawing?

7. In what direction does the grain go on the drawer front?

8. How is the drawer held together?

9. What scale is the drawing made to?

10. How far below the top of the drawer is the top of the handle?

11. Is the handle centered up and down on the drawer front? Explain how you know.

12. How many pieces of plywood make up the drawer?

13. How many <u>different</u> size parts are there?

Bill of Materials
Information and Instruction Sheet

The print reading activity you have just completed gave you practice on retrieving information from and understanding the components of good plans. This understanding will allow you to complete the next activity, filling out a **bill of materials.** Much of the information necessary to build a product is found on the plans, but it is not in a usable form. The purpose of a bill of materials is to identify individual parts, give their sizes, the quantity needed, kind of material used, and cost.

In filling out a bill of materials a variety of information must be selected from the plans, arranged and calculated to make it more useful. We are working with wood materials so the information given will relate to them. First, each part that is different in size or material must be identified and given a **name**. Some common examples are: top, back, bottom, shelf, styles and rails. The front frames on many cabinets are made from parts called rails and styles. Rails are horizontal pieces and styles are vertical pieces. Try and choose logical names for the parts of your project. Next, the total **number of pieces** needed for each part must be determined. The third task is to list the squaring dimensions. **Squaring dimensions** are the exact size of each different piece as indicated on the plans. Be careful not to confuse the sizes of individual parts with the total dimensions of the entire product. Make sure to add or delete sizes for joints if they are part of the piece. Dimensions for a part are usually given in the following order: **thickness, width, and length**. You will find this is the order used on the bill of materials form. The length usually is the longest dimension and goes with the grain.

Now take your drawer plans and bill of materials form and fill out the number of pieces and squaring dimensions sections only. You will notice part of it is filled out as an example. Upon completion, take them to the instructor for checking. **STOP!**

After your instructor has checked your bill of materials form and you have corrected any errors, you may proceed.

The next section of the bill of materials is used for listing **roughing dimensions**. This section is needed because the actual size of the material you start to work with needs to be larger than the final size to allow for machining operations. In most cases, the **number of pieces** for roughing will be the same as squaring. One exception would be when pieces are shorter than 10". In that case, several pieces would be combined together to make a piece longer than 10" to allow for machining safety. Another exception would occur if several parts are glued together to make a thick leg or wide panel. In these cases, you will need further directions from your instructor on the proper listings. For this assignment only, we will keep the number of pieces for roughing and squaring the same.

The **rough thickness** for lumber is normally shown as 1", as that is how it is sold. The thickness for sheet materials, like plywood, hardboard, and particleboard, is listed according to actual size - 1/4", 1/2", 3/4", etc.

When listing the **rough width,** you may need to work with fractions. To make the task easier, first round the fractional dimension up or down to the nearest whole number. If the fraction is less than 1/2", round down. If 1/2" and greater, round up. For example, 6-1/8" would be rounded down to 6" and 6-5/8" would be rounded up to 7". Narrow **lumber** parts, 6" and less, are usually made from one board. Parts wider than 6" are made from several pieces. To make wider boards requires machining operations. To allow for this machining, extra width must be added to the squaring width. Therefore, after rounding the squaring width, add to it according to the following scale to get the roughing width.

Width:	Add:	Width:	Add:	Width:	Add:
0-6"	+1/2"	13-15"	+2"	22-24"	+3 1/2"
7-9"	+1"	16-18"	+2 1/2"	25-27"	+4"
10-12"	+1 1/2"	19-21"	+3"	28-30"	+4 1/2"

Remember this procedure is used for **lumber parts only!** For parts that

are made from plywood, particleboard, and hardboard, round to the nearest whole number and **add 1"** to the squaring width.

Figuring the **roughing length** is much simpler. Just round the squaring length to the nearest whole number and add 1" regardless of the type of material used. Now fill out the roughing dimensions section of the bill of materials, have it checked by your instructor. **STOP!**

The next column is used for listing **board** or **square feet**. Lumber is sold by the board foot, 1" x 12" x 12". Sheet stock is sold by the square foot, 12" x 12", regardless of thickness. You need to convert the roughing sizes into these kinds of units. To do that, use a **board measure table.** One is included in your packet. Take a look at it. You can see it is really no more than an area chart. Width sizes are listed across the top and length sizes are listed down the side. To use it, locate the width dimension on top and the length dimension on the side. Slide your fingers down and across until they meet. The number shown is the board or square feet in one piece that size. Be careful not to lose the decimal point. If there is only one part this size, write the number in the box provided in the board or square foot column corresponding to the roughing size calculated. If there is more than one piece the same size, draw a diagonal line through the box and put the quantity in one piece above the line and the total for all the pieces that size below the line. See example.

Number of pieces	Roughing Dimensions			Board or Square Feet
	Thick.	Width	Length	
1	1"	4"	12"	.33
5	1"	4"	12"	.33 / 1.65

Go ahead and fill in this section and have it checked by your instructor.
STOP!

The last two columns are for the unit and total costs. **Unit cost** is how much one unit of a particular material costs. For example, pine lumber costs $.90/board foot and 3/8" plywood sells for $.45/square foot. Use these costs to fill out the unit cost column on your sheet. **STOP!**

The **total cost** is determined by multiplying the total board or square feet for all the parts that size times the unit cost for the material given. This calculation will result in the cost in dollars and cents. Go ahead and complete the last column and have it checked by your instructor. **STOP!**

When all parts of your sample bill of materials are complete and correct, you are ready to try making one for your own project. Get blank bill of materials sheets from your instructor and fill them out using your plans. After you have completed the squaring dimensions, remember to have your work checked to catch any errors. Failure to do this may result in a lot of unnecessary work. If you have questions on any part, go back and read through the information instruction sheet. If you are still having difficulty, ask a classmate for assistance. or get your help from your instructor.

Bill of Materials

Project _____ Name _____

Date _____

Name of piece	Number of pieces	Squaring Dimensions			Number of pieces	Roughing Dimensions			Board or Square Feet	Cost Per. Unit	Total Cost
		Thick.	Width	Length		Thick.	Width	Length			
Front											
Back											
Sides											
Bottom											
Divider											
Handle											

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BOARD MEASURE TABLE

WIDTH IN INCHES

	1	1-1/2	2	2-1/2	3	3-1/2	4	5	6	7	8	9	10	11	12	13	14
1												.09	.09	.09	.09	.09	.09
2								.07	.08	.09	.11	.13	.14	.15	.16	.18	.19
3						.08	.09	.1	.12	.14	.16	.19	.21	.23	.25	.27	.29
4					.08	.1	.11	.14	.16	.19	.22	.25	.28	.3	.33	.36	.39
5				.08	.1	.12	.14	.17	.21	.24	.28	.31	.35	.38	.41	.45	.48
6			.08	.1	.12	.14	.18	.21	.25	.29	.33	.37	.41	.45	.50	.54	.58
7			.09	.12	.14	.16	.19	.24	.29	.33	.39	.43	.49	.53	.58	.63	.68
8		.09	.11	.14	.16	.18	.22	.28	.33	.38	.44	.50	.55	.61	.66	.72	.78
9		.09	.13	.16	.19	.21	.25	.31	.37	.43	.5	.56	.62	.68	.75	.81	.88
10		.1	.14	.17	.21	.24	.28	.35	.41	.49	.55	.62	.69	.76	.83	.9	.98
11		.11	.15	.19	.23	.27	.3	.38	.46	.53	.61	.68	.76	.84	.92	.99	1.06
12	.09	.13	.16	.2	.25	.29	.33	.41	.5	.58	.66	.75	.83	.91	1.	1.08	1.16
13	.09	.14	.18	.22	.27	.31	.36	.45	.54	.63	.72	.81	.9	1.	1.08	1.17	1.26
14	.09	.14	.19	.24	.29	.33	.39	.48	.58	.68	.77	.88	.98	1.07	1.16	1.26	1.36
15	.1	.15	.2	.26	.31	.35	.41	.52	.62	.73	.83	.94	1.04	1.15	1.25	1.35	1.46
16	.11	.16	.22	.28	.33	.37	.44	.55	.66	.78	.89	.1	1.12	1.22	1.33	1.44	1.55
17	.12	.18	.24	.29	.35	.39	.47	.59	.71	.83	.94	1.06	1.17	1.29	1.41	1.53	1.65
18	.13	.19	.25	.31	.37	.42	.5	.62	.75	.87	1.	1.12	1.25	1.37	1.5	1.62	1.75
19	.13	.2	.26	.33	.39	.44	.52	.65	.79	.92	1.05	1.18	1.31	1.44	1.58	1.71	1.84
20	.14	.21	.28	.35	.42	.46	.55	.7	.83	.97	1.1	1.25	1.39	1.53	1.66	1.8	1.94
21	.14	.22	.29	.36	.44	.49	.58	.73	.88	1.02	1.16	1.31	1.46	1.61	1.75	1.89	2.04
22	.15	.23	.3	.38	.46	.52	.61	.76	.92	1.07	1.22	1.37	1.52	1.68	1.83	1.98	2.14
23	.16	.24	.32	.4	.48	.55	.64	.8	.96	1.12	1.28	1.42	1.59	1.76	1.91	2.07	2.24
24	.16	.25	.33	.41	.50	.57	.66	.83	1.	1.16	1.33	1.5	1.66	1.83	2.	2.16	2.33
25	.17	.26	.34	.43	.52	.59	.69	.87	1.04	1.21	1.39	1.55	1.73	1.91	2.08	2.25	2.43
26	.18	.27	.36	.45	.54	.62	.72	.9	1.08	1.26	1.44	1.61	1.8	1.98	2.16	2.34	2.53
27	.18	.28	.38	.47	.56	.65	.75	.94	1.12	1.3	1.5	1.67	1.88	2.06	2.25	2.43	2.62
28	.19	.29	.39	.49	.58	.67	.78	.97	1.16	1.38	1.55	1.73	1.94	2.14	2.33	2.52	2.72
29	.20	.3	.4	.5	.6	.69	.8	1.	1.20	1.41	1.6	1.8	2.	2.21	2.41	2.61	2.82
30	.20	.31	.41	.52	.62	.72	.83	1.04	1.24	1.45	1.66	1.86	2.08	2.29	2.5	2.7	2.92
31	.21	.32	.42	.54	.64	.76	.86	1.07	1.29	1.5	1.72	1.92	2.15	2.36	2.58	2.79	3.01
32	.22	.33	.44	.55	.66	.78	.89	1.11	1.33	1.55	1.78	1.98	2.22	2.42	2.66	2.88	3.11
33	.23	.34	.46	.57	.68	.81	.92	1.14	1.37	1.6	1.83	2.06	2.29	2.51	2.75	2.97	3.21
34	.23	.35	.47	.59	.71	.83	.95	1.18	1.41	1.65	1.89	2.10	2.36	2.60	2.83	3.06	3.3
35	.24	.36	.48	.61	.73	.85	.98	1.21	1.45	1.7	1.94	2.17	2.43	2.67	2.91	3.15	3.4
36	.25	.37	.5	.62	.75	.87	1.	1.25	1.5	1.75	2.	2.25	2.5	2.75	3.	3.25	3.50

MATERIAL PRICE LIST 1989-90

LUMBER

1"	Oak	$ 1.11 / Board Foot
2"	Oak	$ 1.80 / " "
1"	Walnut	$ 2.40 / " "
2"	Walnut	$ 2.50 / " "
1"	Cherry	$ 1.55 / " "
1"	Pine	$ 1.00 / " "
1"	Mahogany	$ 1.65 /" "
1"	Maple	$ .90 / " "
1"	Butternut	$ .97 /" "

PARTICLEBOARD

1/2"	$ .35 / " "
3/4"	$ .45 / " "

HARDBOARD

1/8"	$ .25 / Square Foot
1/4"	$ .35 / " "

HARDWOOD PLYWOOD

1/2"	Oak	$ 1.25 / Square Foot
3/4"	Oak	$ 1.35 / " "

SUPPLIES

Aprons	$ 3.45 each
Safety Glasses	$ 3.00 "
Safety Goggles	$ 2.00 "

36" MAPLE DOWELS

1/8"	$ .10 ea.	3/16"	$ .15 ea.
1/4"	$ .18 ea	5/16"	$ .23 ea.
3/8"	$ .29 ea.	7/16"	$ .39 ea.
1/2"	$ .49 ea.	5/8"	$ .70 ea.
3/4"	$ 1.15 ea.	1"	$ 1.94 ea.
1-1/8"	$ 1.55 ea.	1-1/4"	$ 3.15 ea.

HARDWARE

Handles	-	$.1.00 ea.
Hinges 3/8" offset	-	$ 1.00 / set
Drawer Guides	-	$ .50 / set
Piano Hinge	-	$ .15 / inch
Bed Rail Hardware	-	$ 12.50 / set
Decorative Plugs	-	$ .04 ea.

DRY WALL SCREWS

1"	$ .02 ea.
1-1/4"	$ .02 "
1-5/8"	$ .02 "
2"	$ .04 "
2-1/2"	$ .04 "
3"	$ .04 "
3-1/2"	$ .O5 "

PLASTIC MATERIALS

Fiberglass Cloth	-$ .30 /	Square Foot
Fiberglass Mat	- $ .25 /	"
Finishing Mat	- $ .50 /	"
Resin	- $ 1.50 / Pint	$ .15/ oz.
Creeper Wheels	- $ 13.60 / set of 4	

Bill of Materials

Project _____ Name _____

Date _____

Name of piece	Number of pieces	Squaring Dimensions			Number of pieces	Roughing Dimensions			Board or Square Feet	Cost Per. Unit	Total Cost
		Thick.	Width	Length		Thick.	Width	Length			

20

Name _____

Post-Test
Planning Module

1. Why are notes often added to drawings?

2. What is the primary purpose of arrows on a drawing?

3. Why are three view drawings commonly used for project plans?

4. What are squaring dimensions?

5. Why are dimensions put on blue prints? What are the two common types?

6. Why is lumber listed as 1" in thickness when it is usually thinner?

7. Why are drawings usually drawn to scale?

8. What does 1/2" scale mean?

9. What are three things a good set of project plans would show?

10. In what order are the dimensions for a piece of lumber given?

11. What do hidden lines on a drawing show?

12. What are three types of information that would be found on a bill of materials?

13. What are rails and styles?

14. How are size and location dimensions different from each other?

15. Why is a complete set of project plans necessary before starting a project?

16. Why is it necessary to have a Bill of Materials before starting a project?

17. Why is the front view on a drawing usually made first?